Analysis of the cost and benefits of mitigation of reactive nitrogen emission in the contrasting agricultural systems of Spain, France and the Netherlands

Luis Lassaletta[1], Hans van Grinsven[1], Lex Bouwman[1], Sietske van der Sluis[1], Fernando Estellés[2], Agustín del Prado[3], Gilles Billen[4], Josette Garnier[4], Alberto Sanz-Cobena[5]

[1] PBL Netherlands Environmental Assessment Agency, 3720 A H Bilthoven, The Netherlands

[2] ICTA, Universitat Politécnica de Valencia, Camino de Vera s/n 46022, Valencia, Spain

[3] Basque Centre For Climate Change (BC3), Alameda Urquijo, 4, 4°-1a/48008 Bilbao, Spain

[4] Centre National de la Recherche Scientifique (CNRS), UMR 7619 Metis, 4 place Jussieu, Paris, France

[5] ETSI Agrónomos. Universidad Politécnica de Madrid. Av. Complutense s/n, 28040, Madrid, Spain

luis.lassaletta@pbl.nl

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Ammonia emissions in Spain have risen over 13% from 1990 to 2012 (332 and 380 Gg/year respectively,) and together with the Netherlands Spain is one of countries that may surpass, in the upcoming assessment, the threshold established in the Gothenburg Protocol for 2010. A recent study has shown how several alternative management practices could significantly reduce the NH_3 emissions and, in some cases, without any reduction of yields. In this work we go further and we provide an assessment of the costs and benefits of 11 different mitigation scenarios also taking into account the effects on nitrate leaching and nitrous oxide emissions for the Spanish cropping systems in 2008. Differences between irrigated and rainfed systems were considered. Considered costs were those associated with actual mitigation and yield loss. Considered benefits were those associated with reduced use and a decreased of environmental impacts due to the reduction emissions of reactive N. The results show how in 7 of the 11 studied scenarios the final benefit is higher than the business as usual situation (BAU). In all of these 7 cases there are net benefits for the farmer and for society in view of reduced damage associated to reactive N emissions. We conclude that there is ample scope to reduce reactive N emissions with very low or no agricultural penalty and with substantial benefits for society. In 6 of these scenarios the associated NH_3 reduction will also result in an accomplishment of emissions ceilings for ammonia under the EU NEC directive. In the finale paper the results for Spain as an example of farming in Mediterranean climate regime will be compared with France and the Netherland as example of two agriculture systems operating in a temperate climate regime.